

HP Apollo 8000 System

Monitoring and Controls



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HP Apollo 8000 System

Leading performance density

HP Apollo f8000 Rack



Dry disconnect server trays



HP ProLiant XL730f
2x2P Servers



HP ProLiant XL740f
2P+2 Accelerators



HP ProLiant XL750f
2P+2 GPUs



HP InfiniBand Switch for
Apollo 8000 System

Efficient liquid cooling without the risk

HP Apollo 8000 iCDU Rack



HP Apollo 8000 Cooling Circuit



Apollo 8000 System Technologies

Advancing the science of supercomputing

Intelligent Cooling Distribution Unit

- 320 KW power capacity
- Integrated controls with active-active failover

Dry-disconnect servers

- 100% water cooled components
- Designed for serviceability

Warm water

- Closed secondary loop in CDU
- Isolated and open facility loop

Management infrastructure

- HP iLO4, IPMI 2.0 and DCMI 1.0
- Rack-level Advanced Power Manager

Power infrastructure

- Up to 80kW per rack
- Four 30A 3-phase 380-480VAC

Raised Floor



Open door view of 4 f8000, redundant iCDU racks and underfloor plumbing kit

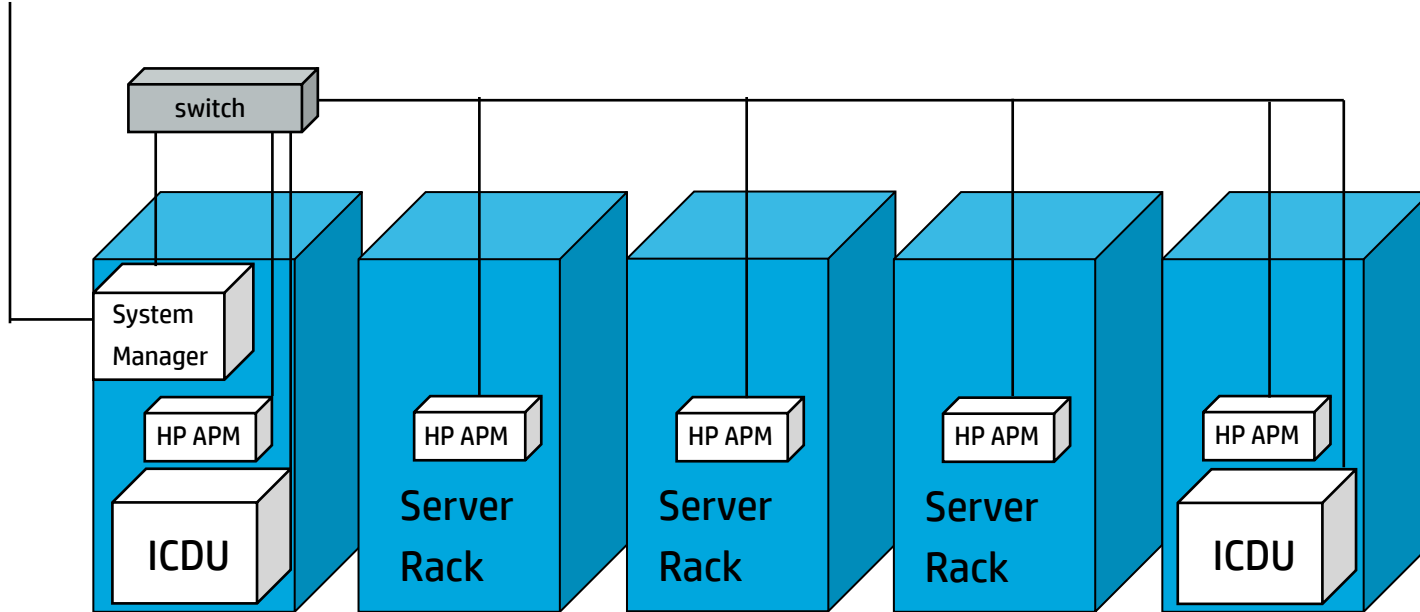
HP System Manager v1.0 Objectives

- **Provide insight into the Apollo 8000 water-cooled infrastructure**
- **Provide solution-level and component-level views**
- **Display sensor history for trending and analysis**
- **Send email when alerts are detected**



HP System Manager network topology

Lab Network



HP System Manager

Launch the Main Display

All racks are displayed and colored based on alert summary

All current alerts are displayed

Click on the components to see more detail

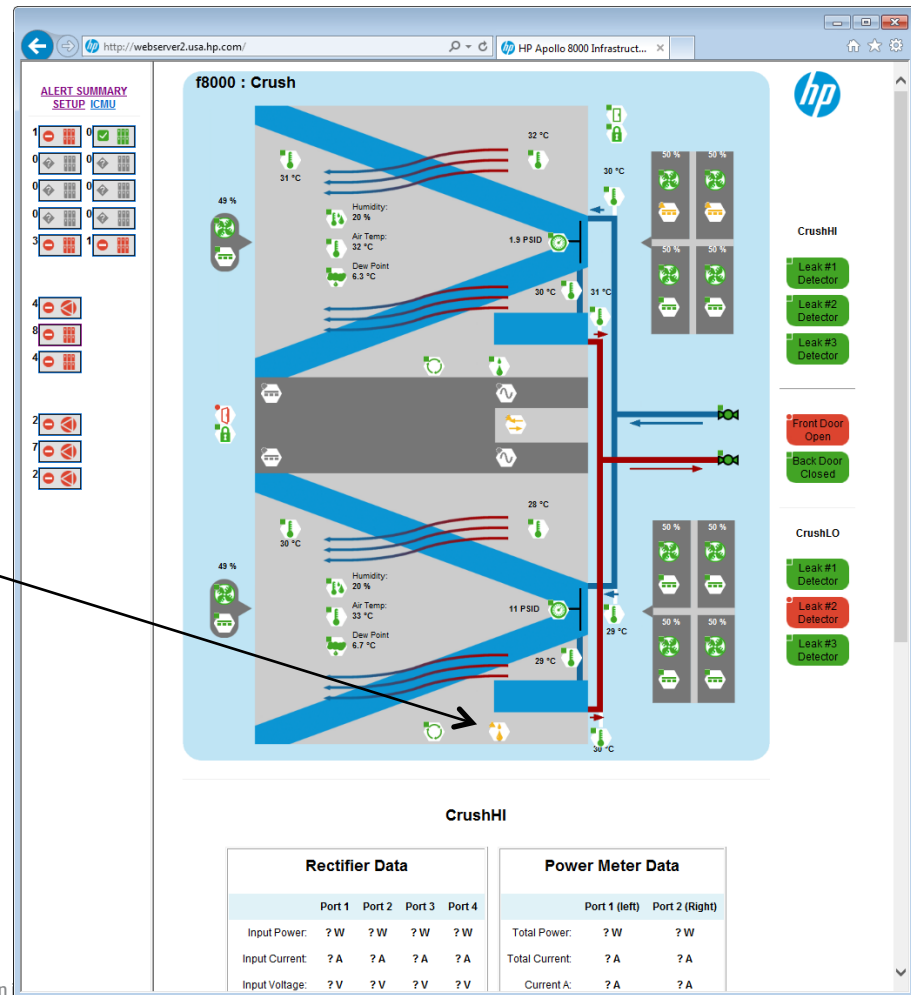
Rack firmware table below

The screenshot shows the HP System Manager web interface. The browser address bar displays 'http://apollo.company.com/'. The page title is 'HP Apollo 8000 Infrastruct...'. The main content area is titled 'ALERTS as of Mon Jan 26 06:55:50 EST 2015'. On the left, there is a sidebar with 'ALERT SUMMARY', 'SETUP', and 'ICMU' links. Below these are icons for racks, each with a colored status indicator (red for critical, yellow for warning, green for OK). The main area displays a table of alerts. Below the alerts table, there is a section titled 'Rack Firmware Information' containing a table with rack details.

| Rack | Alert Description | Value | Alert Start Date/Time |
|-------------|---|-------|------------------------------|
| CRUSH-ATLHI | Front Door Sensor | 1 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLHI | Humidity Sensor | 15.58 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLHI | Cell#6 DC Power | 1 | Sun Jan 25 09:07:00 EST 2015 |
| CRUSH-ATLHI | Cell#9 DC Power | 1 | Sun Jan 25 09:07:00 EST 2015 |
| CRUSH-ATLHI | APM PM2 XML ERROR : Error: Ursa Major is not present. | 0001 | Sun Jan 25 09:07:00 EST 2015 |
| CRUSH-ATLHI | APM RECT2 XML ERROR : Error: Ursa Major is not present. | 0001 | Sun Jan 25 09:07:00 EST 2015 |
| CRUSH-ATLLO | Leak Detector #2 | 1 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLLO | Humidity Sensor | 15.18 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLLO | Cell#2 DC Power | 1 | Sun Jan 25 09:07:00 EST 2015 |
| Dory-ATLHI | Humidity Sensor | 14.26 | Sun Jan 25 09:06:55 EST 2015 |
| Dory-ATLLO | APM PM1 XML ERROR : Error: Ursa Major is not present. | 0001 | Sun Jan 25 09:06:55 EST 2015 |
| Dory-ATLLO | APM RECT1 XML ERROR : Error: Ursa Major is not present. | 0001 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey2 | pLAN Communications Offline | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey2 | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey2 | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey3 | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey3 | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | pLAN Communications Offline | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Front Door Sensor | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Back Door Sensor | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Humidity Sensor | 16.04 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | HEX Fan DC Power Supply #1 | 2 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Emergency Power Off Signal | 1 | Sun Jan 25 09:06:55 EST 2015 |

| Rack | APM Firmware Version | APM Firmware Date | ICDU Software Version |
|-----------|----------------------|-------------------|-----------------------|
| CRUSH-ATL | 2.10 | Dec 3 2014 | N/A |
| Dory-ATL | 2.10 | Dec 3 2014 | N/A |
| Flakey | 2.10 | Dec 3 2014 | 3.00 |
| Flakey3 | 2.10 | Dec 3 2014 | 3.00 |
| RACK10 | 2.10 | Dec 3 2014 | N/A |
| Squirt | 2.10 | Dec 3 2014 | 2.00 |

Icons representing sensors change color when values go out of range or an alert is triggered

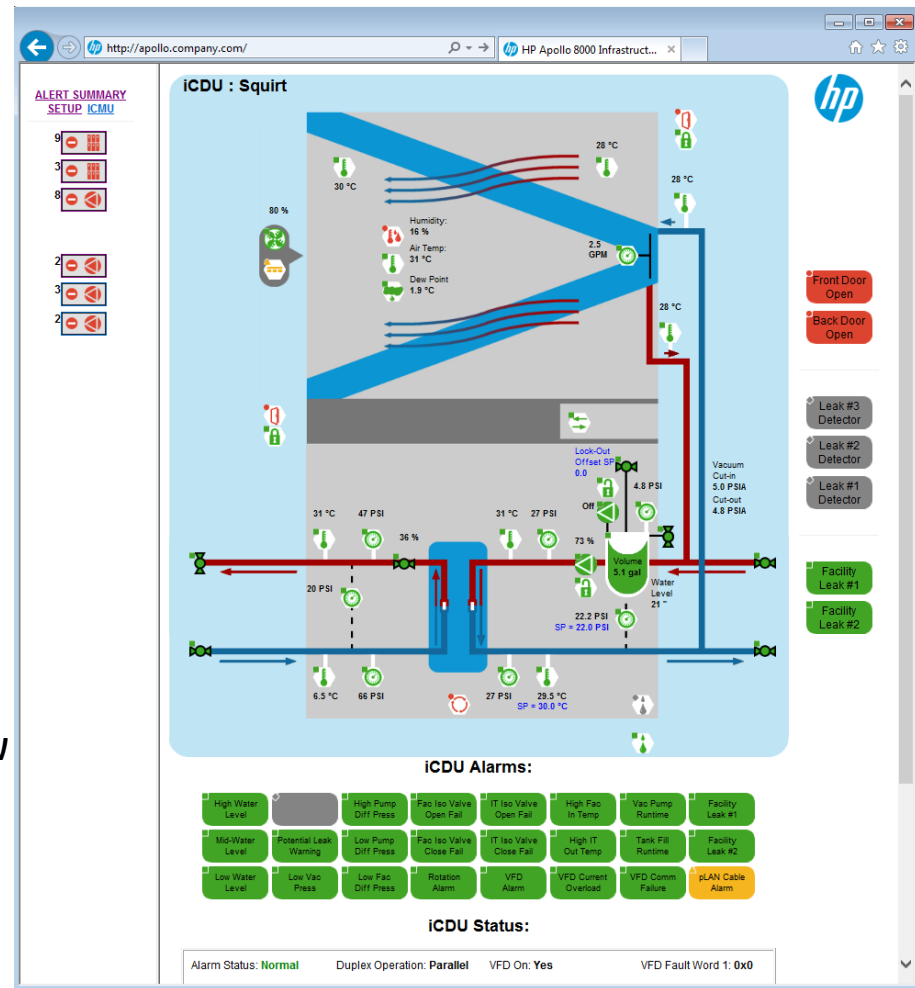


HP System Manager

CDU Rack schematic display

Icons representing sensors change color when values go out of range or an alert is triggered

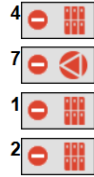
CDU Status and alarm table displayed below



HP System Manager

Plots spanning
the past 24
hours for
pre-selected
metrics are
available

[ALERT SUMMARY](#)
[SETUP](#) [ICMU](#)
[USER GUIDE](#)



Icon Selection
rack schematic [plots](#)

SQUIRT: Facility Inlet Temperature



[*Facility Inlet Temperature](#)

[Facility Outlet Temperature](#)

[IT Pump Discharge Temperature](#)

[IT Heat Exchanger Outlet Temperature](#)

[Air Inlet Valve Is On](#)

[CDU Differential Pressure](#)

[Reservoir Pressure](#)

[VFD Frequency](#)

[VFD Speed](#)

[Central Air Temperature Sensor](#)

[Front Air Temperature Sensor](#)

[Back Air Temperature Sensor](#)

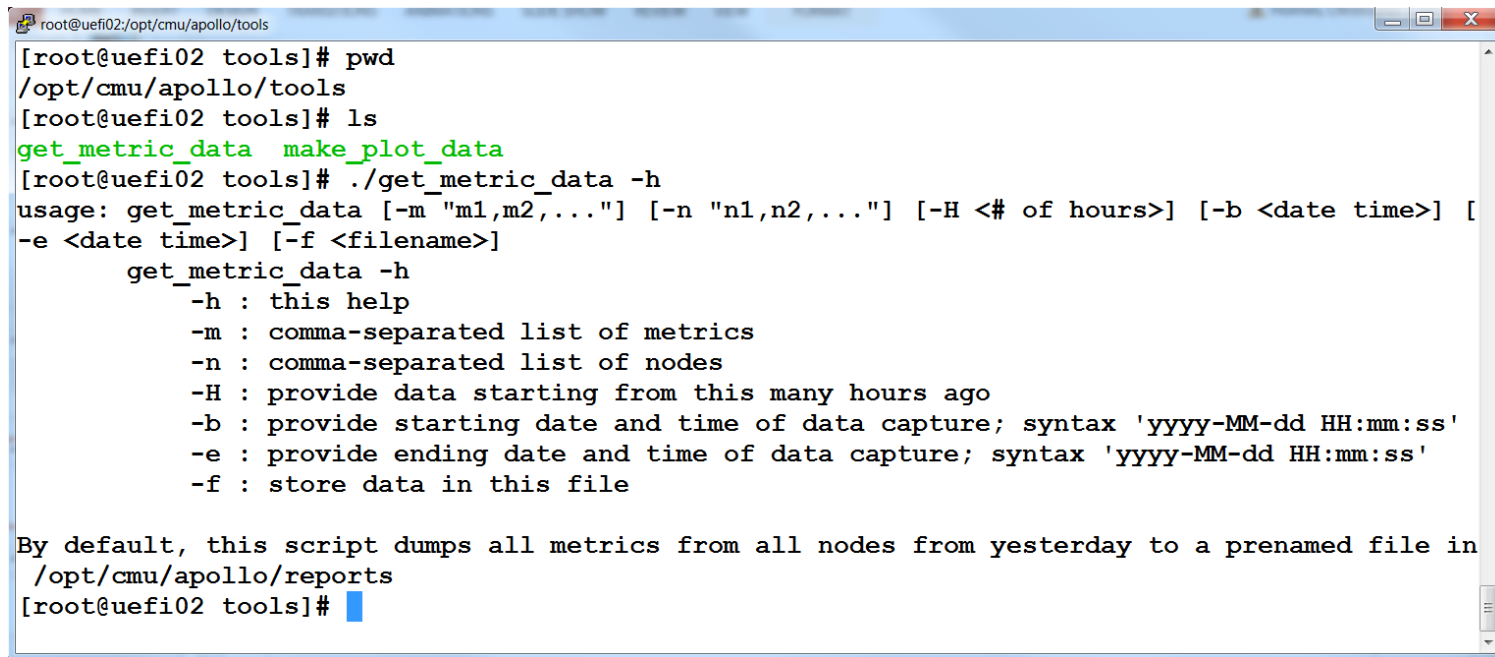
[Supply Water Temperature Sensor](#)

[Return Water Temperature Sensor](#)

Use mouse to select region in either graph (upper detail graph or lower full graph) to view in detail graph.

HP System Manager

- Every bit of metric data is preserved in the HP Insight CMU database
- Any and all data can be extracted to CSV files



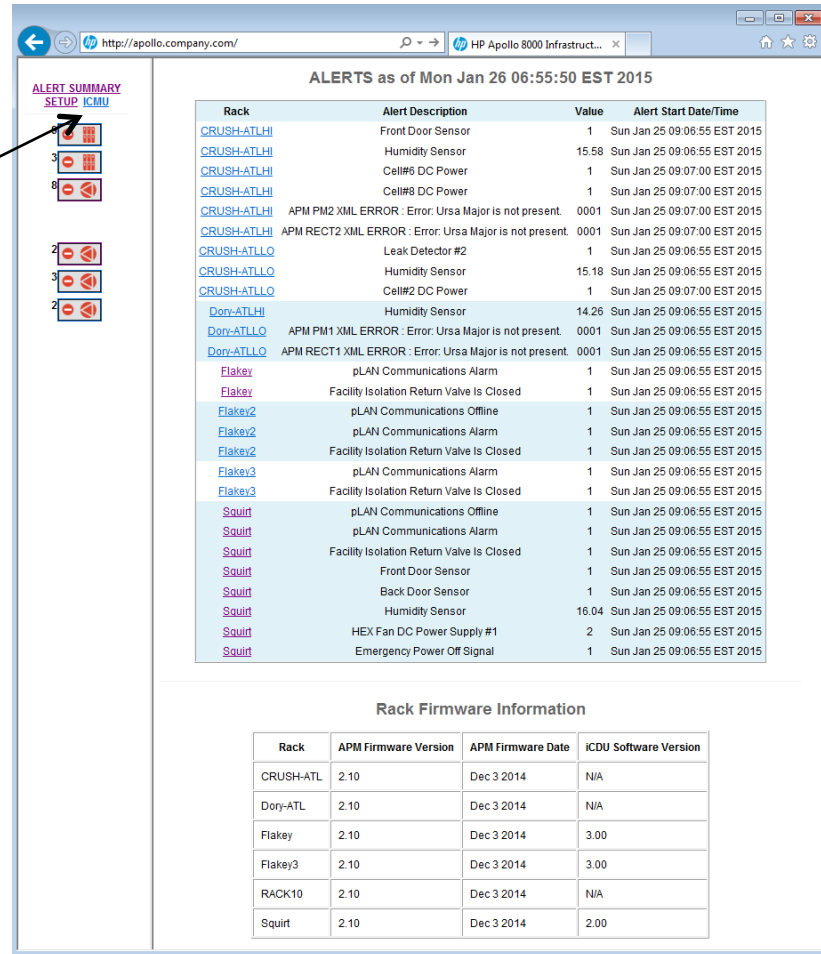
```
root@uefi02:/opt/cmu/apollo/tools
[root@uefi02 tools]# pwd
/opt/cmu/apollo/tools
[root@uefi02 tools]# ls
get_metric_data  make_plot_data
[root@uefi02 tools]# ./get_metric_data -h
usage: get_metric_data [-m "m1,m2,..."] [-n "n1,n2,..."] [-H <# of hours>] [-b <date time>] [-e <date time>] [-f <filename>]
    get_metric_data -h
        -h : this help
        -m : comma-separated list of metrics
        -n : comma-separated list of nodes
        -H : provide data starting from this many hours ago
        -b : provide starting date and time of data capture; syntax 'yyyy-MM-dd HH:mm:ss'
        -e : provide ending date and time of data capture; syntax 'yyyy-MM-dd HH:mm:ss'
        -f : store data in this file

By default, this script dumps all metrics from all nodes from yesterday to a prenamed file in
/opt/cmu/apollo/reports
[root@uefi02 tools]#
```



HP System Manager

To view/analyze sensor history,
use HP Insight CMU



The screenshot shows the HP System Manager web interface. The left sidebar contains a navigation menu with icons for various system components. A red arrow points from the text 'To view/analyze sensor history, use HP Insight CMU' to the 'ALERT SUMMARY' tab in the sidebar. The main content area displays a table of alerts under the heading 'ALERTS as of Mon Jan 26 06:55:50 EST 2015'. The table has four columns: Rack, Alert Description, Value, and Alert Start Date/Time. Below the alerts table, there is a section titled 'Rack Firmware Information' containing a table with four columns: Rack, APM Firmware Version, APM Firmware Date, and iCDU Software Version.

| Rack | Alert Description | Value | Alert Start Date/Time |
|-------------|---|-------|------------------------------|
| CRUSH-ATLHI | Front Door Sensor | 1 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLHI | Humidity Sensor | 15.58 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLHI | Cell#6 DC Power | 1 | Sun Jan 25 09:07:00 EST 2015 |
| CRUSH-ATLHI | Cell#8 DC Power | 1 | Sun Jan 25 09:07:00 EST 2015 |
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| CRUSH-ATLLO | Leak Detector #2 | 1 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLLO | Humidity Sensor | 15.18 | Sun Jan 25 09:06:55 EST 2015 |
| CRUSH-ATLLO | Cell#2 DC Power | 1 | Sun Jan 25 09:07:00 EST 2015 |
| Dory-ATLHI | Humidity Sensor | 14.26 | Sun Jan 25 09:06:55 EST 2015 |
| Dory-ATLLO | APM PM1 XML ERROR : Error: Ursa Major is not present. | 0001 | Sun Jan 25 09:06:55 EST 2015 |
| Dory-ATLLO | APM RECT1 XML ERROR : Error: Ursa Major is not present. | 0001 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey2 | pLAN Communications Offline | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey2 | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey2 | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey3 | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Flakey3 | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | pLAN Communications Offline | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | pLAN Communications Alarm | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Facility Isolation Return Valve Is Closed | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Front Door Sensor | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Back Door Sensor | 1 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Humidity Sensor | 16.04 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | HEX Fan DC Power Supply #1 | 2 | Sun Jan 25 09:06:55 EST 2015 |
| Squirt | Emergency Power Off Signal | 1 | Sun Jan 25 09:06:55 EST 2015 |

| Rack | APM Firmware Version | APM Firmware Date | iCDU Software Version |
|-----------|----------------------|-------------------|-----------------------|
| CRUSH-ATL | 2.10 | Dec 3 2014 | N/A |
| Dory-ATL | 2.10 | Dec 3 2014 | N/A |
| Flakey | 2.10 | Dec 3 2014 | 3.00 |
| Flakey3 | 2.10 | Dec 3 2014 | 3.00 |
| RACK10 | 2.10 | Dec 3 2014 | N/A |
| Squirt | 2.10 | Dec 3 2014 | 2.00 |



HP System Manager

Each circle displays the given metric from all components so that the values can be compared to each other.

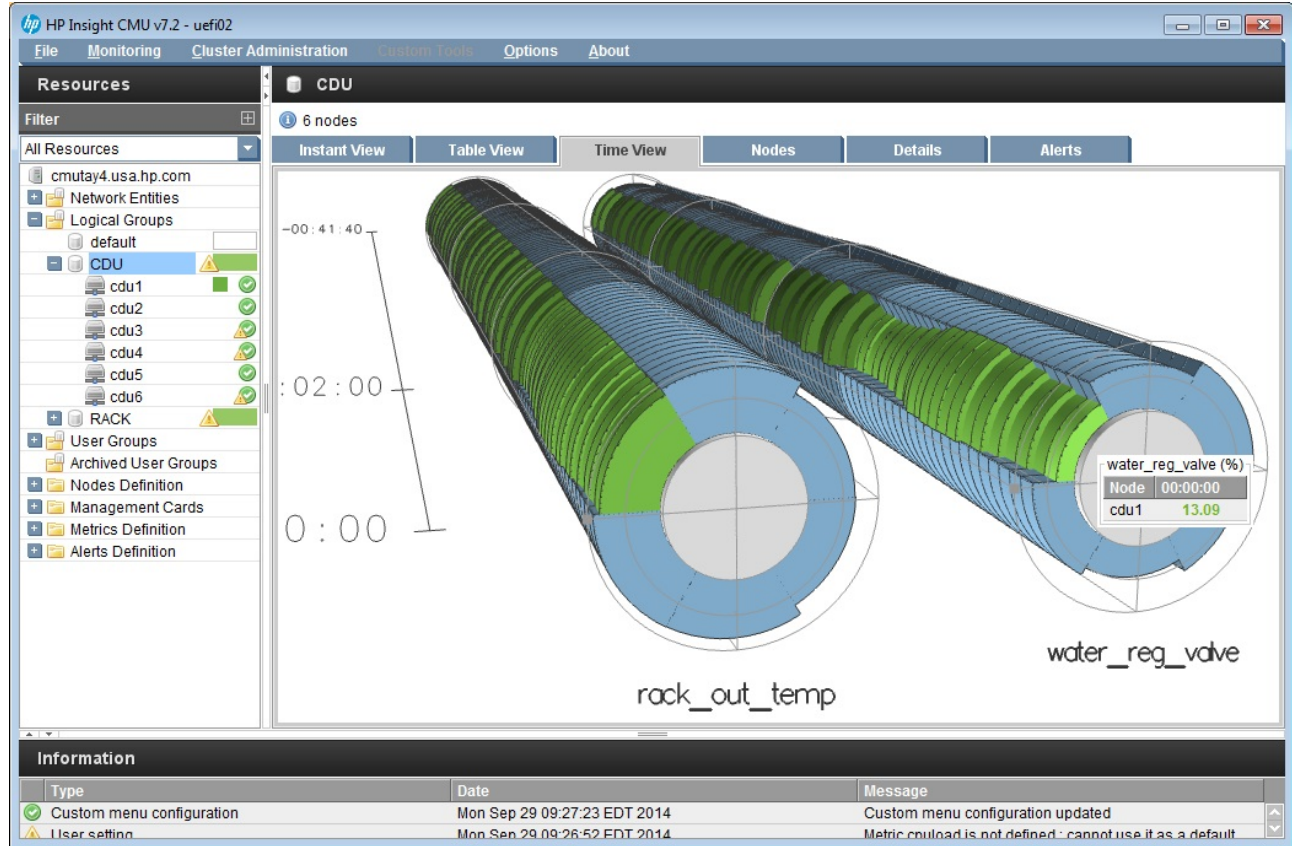
This display makes it easy to identify outliers (etc. hottest/coolest/fastest/slowest component)



HP System Manager

HP Insight CMU Time View displays the same metric “circles” with history, so that patterns in the data can be seen.

You can click on the component slices to change their color so you can correlate the component across the circles



Thanks



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cholmes@hp.com

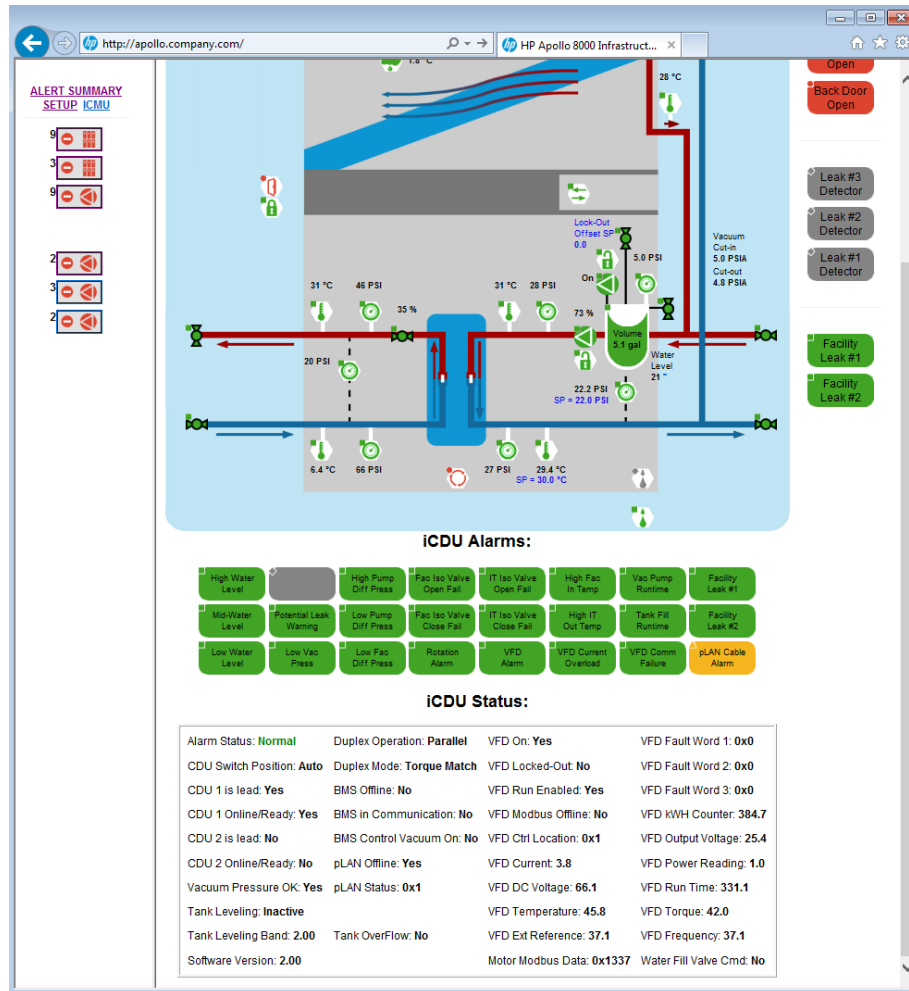


<http://www.hp.com/go/apollo>

Backup slides



HP System Manager



HP System Manager Pre-Configuration Requirements

- **Each HP APM configured with known IP address and username/password**
- **HP APM in CDU rack is configured with CDU IP address**
- **HP APM has secure XML enabled ('enable xml secure')**
- **System Manager server configured with appropriate IP addresses**
 - One internal IP address on “infrastructure” network connected to APMs
 - One external IP address connected to lab network



Gathering the data from APM

```
root@uefi02:/opt/cmu/apollo/apm
[root@uefi02 apm]# pwd
/opt/cmu/apollo/apm
[root@uefi02 apm]# ls xml
get_all_compute_power.xml  get_fw_version.xml      get_rectifier_data.xml
get_cdu_info.xml           get_power_load.xml      get_thermal_status.xml
get_cdus.xml               get_power_meter_data.xml get_warnings.xml
get_event_log.xml          get_rack_info.xml
get_fault_log.xml          get_rack_topology.xml
[root@uefi02 apm]#
[root@uefi02 apm]#
[root@uefi02 apm]# cat xml/get_thermal_status.xml
<SLAPMCL VERSION="2.0">
<LOGIN USER_LOGIN="XXUSERXX" PASSWORD="XXPASSXX">
<GET_THERMAL_STATUS/>
</LOGIN>
</SLAPMCL>
[root@uefi02 apm]#
[root@uefi02 apm]#
[root@uefi02 apm]# curl -k -X POST -Hcontent-type:application/xml -d@/tmp/xmlfile https://192.168.3.1
```



Gathering data from the APM

```
root@uefi02:/opt/cmu/apollo/apm
<SLAPMCL VERSION="1.00" >
<RESPONSE STATUS="0000" MESSAGE="No Error." />
<GET_THERMAL_STATUS>
<GET_THERMAL_STATUS_UPPER>
<SENSORS>
<SENSOR NAME="Leak Detector" INDEX="1" STATUS="no leaks" />
<SENSOR NAME="Leak Detector" INDEX="2" STATUS="no leaks" />
<SENSOR NAME="Leak Detector" INDEX="3" STATUS="no leaks" />
<SENSOR NAME="Door Sensor" INDEX="1" STATUS="closed ( front )" />
<SENSOR NAME="Door Sensor" INDEX="2" STATUS="closed ( rear )" />
<SENSOR NAME="Valve Sensor" INDEX="1" STATUS="not present" />
<SENSOR NAME="Valve Sensor" INDEX="2" STATUS="not present" />
<SENSOR NAME="Water Temp (RTD)" INDEX="1" STATUS="29.7425 degC ( supply )" />
<SENSOR NAME="Water Temp (RTD)" INDEX="2" STATUS="30.4925 degC ( intermediate )" />
<SENSOR NAME="Water Temp (RTD)" INDEX="3" STATUS="31.5863 degC ( return -bot )" />
<SENSOR NAME="Flow" INDEX="1" STATUS="1.92560 PSI (689.00 mV reading)" />
<SENSOR NAME="Temp-Humid -board" INDEX="1" STATUS="32.03 degC, 22.46 %RH" />
<SENSOR NAME="Dew Point Temp." INDEX="1" STATUS="7.93 degC" />
<SENSOR NAME="Air Temp." INDEX="1" STATUS="30.7500 degC (Dev 0:0 )" />
<SENSOR NAME="Air Temp." INDEX="7" STATUS="33.2500 degC (Dev 2:0 )" />
<SENSOR NAME="DC/DC Power Supply" INDEX="1" STATUS="654.00 mV (PS 0 - present - OK)" />
<SENSOR NAME="DC/DC Power Supply" INDEX="2" STATUS="655.00 mV (PS 1 - present - OK)" />
</SENSORS>
<CONTROLS>
```

